

# Dirac Drives Limited

Propulsion without propellant  
Antimatter Energy

"The discovery of a new force in nature is the holy grail of particle physics. Our current understanding of the constituents of the Universe fall remarkably short - we do not know what 95% of the Universe is made of or why there is such a large imbalance between matter and anti-matter."

# Antimatter has negative mass

*“Therefore, a modification of the theory is required such that “empty space” takes the role of gravitating, negative masses which are distributed all over the interstellar space.”*

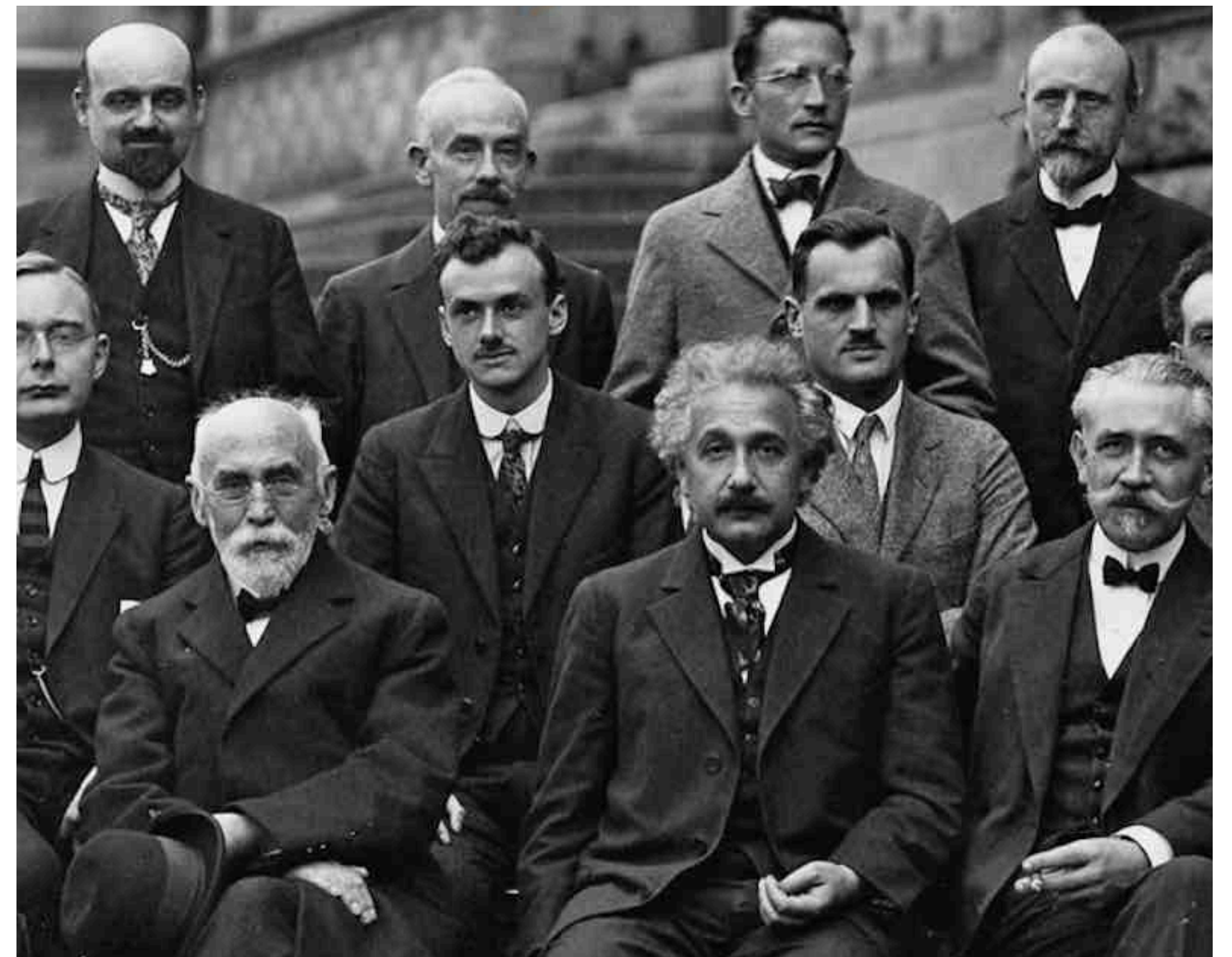
**Albert Einstein**

*“I think that the discovery of antimatter was perhaps the biggest jump of all the big jumps in physics in our century.”*

**Werner Heisenberg**

*“You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete”*

**Buckminster Fuller**



Centre of image left Paul Dirac, right Albert Einstein

# Repulsive Gravity

- Antimatter Propulsion Drives
- Harnessing the power of repulsive gravity to propel humankind in flight, and;
- providing clean energy for the planet, enabling climate change and emissions targets to be met
- Based on developments in: Cosmology, Particle Physics, and Engineering.

The next step of human evolution, the Dirac Drive will propel civilisation forwards. Setting us free, firstly of fossil fuel resource depletion and its adverse impact on the planet, and secondly of the confines of the Earth and the Moon, enabling humankind to become an interstellar species.

# What are Dirac Drives?

## Gravitational Dipoles

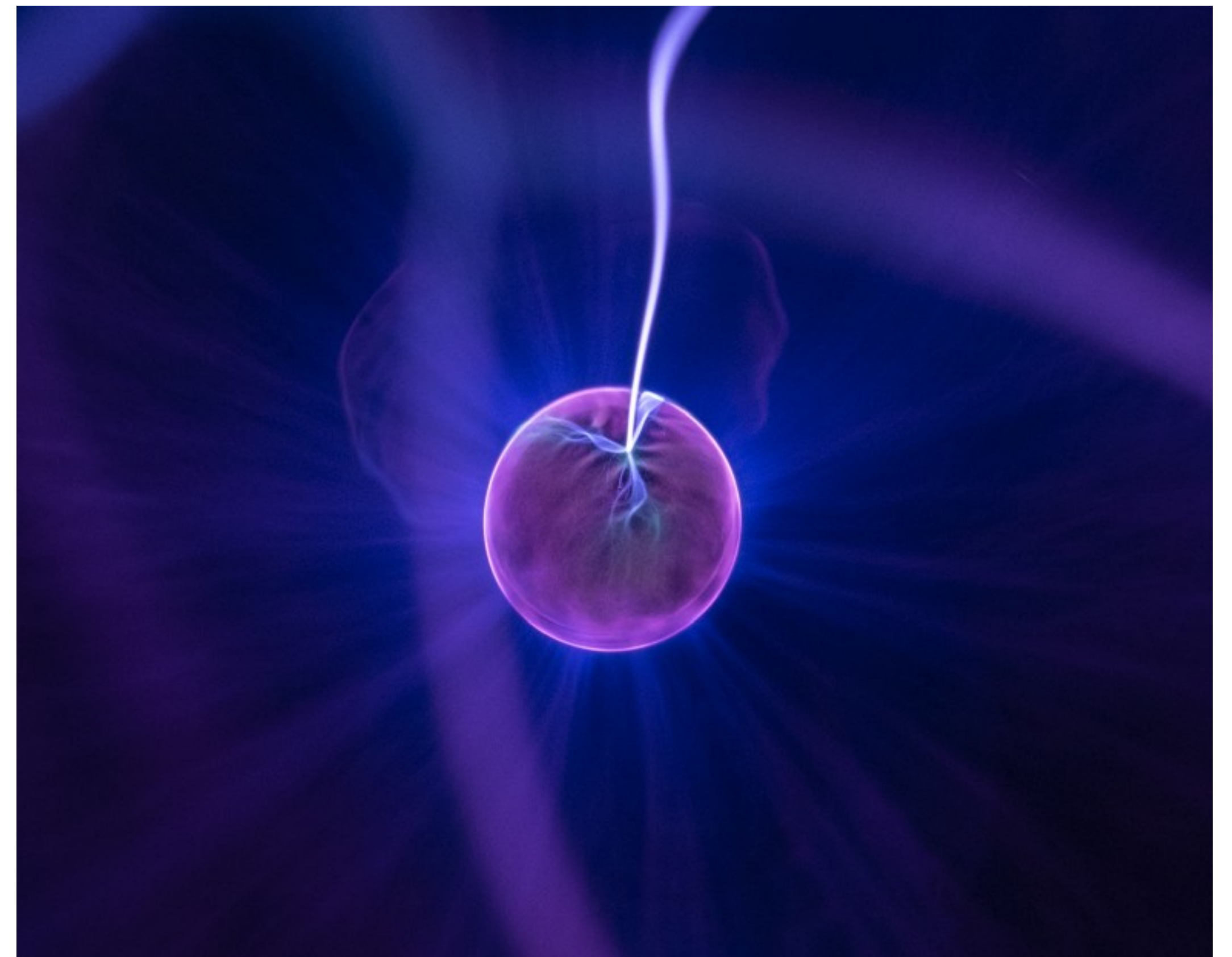
It is possible to create a continuously propulsive effect by the juxtaposition of negative and positive mass.

The poles of negative mass and positive mass may be seen as negative and positive gravitational charges which create a potential gradient between them.

The accelerations for positive mass and negative mass align in the same direction and a self-acceleration effect provides propulsion.

Antimatter has negative mass and there is a strong gravitational force acting between matter and antimatter.

From Clague's [paper](#) on the Composite Photon (2021)



# Cosmology

J. S. Farnes of Oxford University has put forward a negative mass cosmology which provides an explanation for dark matter and dark energy. The current theoretical model can only explain 5% of the universe. Dark matter and dark energy comprise the remaining 95% and represent long-standing unexplained phenomena. The theory provides a good fit to observations of the rotation curves of galaxies, it also provides an explanation of why the universe is expanding at an accelerating rate.

Matter and antimatter tell spacetime how to curve, and the curvature of spacetime tells matter and antimatter how to move.

Given that negative mass is well-supported by theory and evidence, we can ask “where is it”? Important work in two fields operating at vastly different scales in the universe

(cosmology and particle physics) leads to the same conclusion: that negative mass in the universe may be identified with antimatter.



# Particle Physics

The Dirac equation can be interpreted as meaning that antimatter has negative mass.

It is shown that Einstein's gravitational field equations imply the existence of negative masses. Dirac spinors can be composed of large positive and likewise large negative mass.

Our updated understanding is that the photon is a composite particle; an electron-positron pair with the positron having negative mass.

Negative mass is consistent with the Dirac equation and seems more satisfactory or natural than negative energy or moving backwards in time. This goes against Feynman's diagrams in QED but leaves their meaning intact. Perhaps Feynman himself would have updated his understanding of

time to our modern understanding which is that time does not exist at the fundamental level.

$$E = \pm c \sqrt{p^2 + m^2 c^2}$$

# Engineering

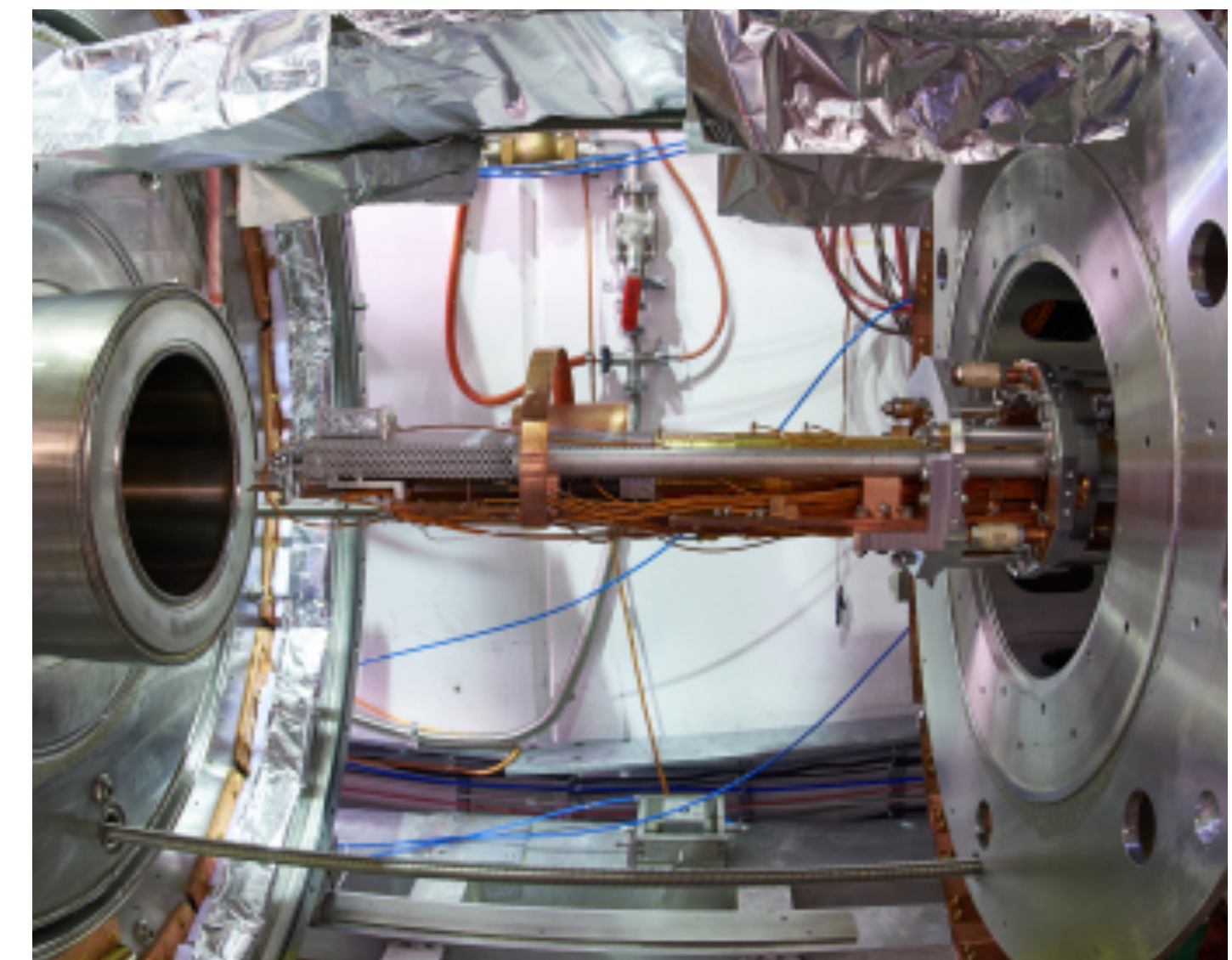
The Dirac Drive uses negative mass for propulsion without propellant, and is constructed using existing technologies.

Positive and negative masses self-accelerate in runaway motion. The force acting on the masses is their mutual gravitational attraction and repulsion.

The positive mass attracts the negative mass while the negative mass repels it. Equal masses will have a net zero mass and self-accelerate up to near to the speed of light. The repulsive force of the negative mass maintains a constant distance between them.

To moderate and control antimatter, we send antimatter particles along a helical path inside a central column. A magnetic field directs the path of the particles inside a magnetic bottle.

Rapid acceleration in any spatial direction can be achieved.





# Who are Dirac Drives Limited?

- Private Limited Company based in Cambridge, United Kingdom
- Licensor of patent pending technology UK IPO Application No. 2103166.1 / US Patent Application No. 17201087
- Inventors of a unique propulsion system with multiple applications
- Business model based on licence fees and ongoing royalty fees
- Clean Energy and Space are rapid growth sectors worth £ Trillions
- Strategy: invest in R&D of new applications for the technology whilst providing consultant technical support to licensees.

# Business Model

- Intellectual Property Company
- Licence fees based on value of end product
- Royalty payments based on use of end product
- Consultant engineers providing technical expertise to licensees
- Commercial antimatter laboratory.

# Features of Dirac Drives

- Propulsion and energy without propellant = no fusion or fission
- Few working parts = lower cost to produce and less potential for failure
- 3D printing = fast build and deployment
- Can propel nearly any craft in any medium - from spacecraft to VTOL cars
- Licence and royalty fees = low up front investment and access to technical support
- Near light speed travel in space, highly maneuverable through any medium - water, air, space, with no inertia, no heat signature, no sonic boom.

# Applications for Dirac Drives

## On Earth

**Flight** - Highly maneuverable with no inertia, no heat signature, no sonic boom.

**Energy** - The Dirac Drive will deliver infinite clean energy for the whole planet's needs.

**Transport** - This is the game changer in travel and transport - completely transforming mechanised vehicles of every kind - personal and commercial travel, shipping (on and below water), deliveries.

**The Previously Impossible** - Dirac Drives enable humans to realise their dreams - floating cities, shops, islands, the potential applications are only just being explored.

## In Space

**Near Earth Orbit and Payload Delivery, Travel, Exploration, Mining, Habitats.**

- Acceleration - 110,000kg Challenger Space Shuttle could reach 936g
- 120 minutes to Mars, Alpha Centauri in under five years
- Propelling interstellar humanity.

# Sizing the opportunity

The global aircraft engine market was valued at \$79.93 Billion in 2019 with the turbofan engine representing circa 75% of the market. (Source: Fortune Business Insights)

The global space propulsion market size is projected to grow from \$6.7 Billion in 2020 to \$14.2 Billion by 2025, at a CAGR of 16.2% from 2020 to 2025. (Source: Oct.2020/PRNewswire)

The global Launch Vehicles segment had a combined market size of \$64.7 Billion in the year 2020. (Source: GlobeNewsWire)

Global energy investment totalled \$1.8 Trillion in 2017. More than \$750 Billion went to the electricity sector while \$715 Billion was spent on oil and gas supply globally. (Source: International Energy Agency)

We predict this technology will inspire multiple new applications and opportunities, spawning multiple, multi-trillion dollar companies.

# Example applications for Dirac Drives

## Mining 16 Psyche

An Iron and nickel asteroid valued at an estimated \$10,000 Quadrillion and orbiting the Sun at around 1.6 times AU (the distance between the Earth and the Sun) located between Mars and Jupiter.

Now easily within reach and using mining equipment developed for use on Mars, it's possible to mine almost limitless resources in Space, enabling humans to return the Earth to the pristine home it should be.

## Space Garbage

Waste is another big problem for humanity.

We currently bury, burn, and release into waterways and seas 3.5 million tons of plastic and solid waste per day...

Using existing rubbish collection systems, all non-recyclable and non-biodegradable waste can be packed into 3D printed graphene 'space bins' and flown into the Sun - 93 million miles distant from Earth at around 1 million miles out from the Sun's surface, the entire payload would be vaporised.

# Global Energy with Dirac Drives

Dirac Drives can replace every current energy source on the planet within years.

The Dirac Drive will deliver clean energy for the entire planet's needs. In the short term our aim is to decommission every fossil fuel power plant on the planet, by substituting these with a Dirac Drive connected to the station generator and on to existing power grids means we can replace the biggest pollutants, switching to clean energy in a very short space of time.

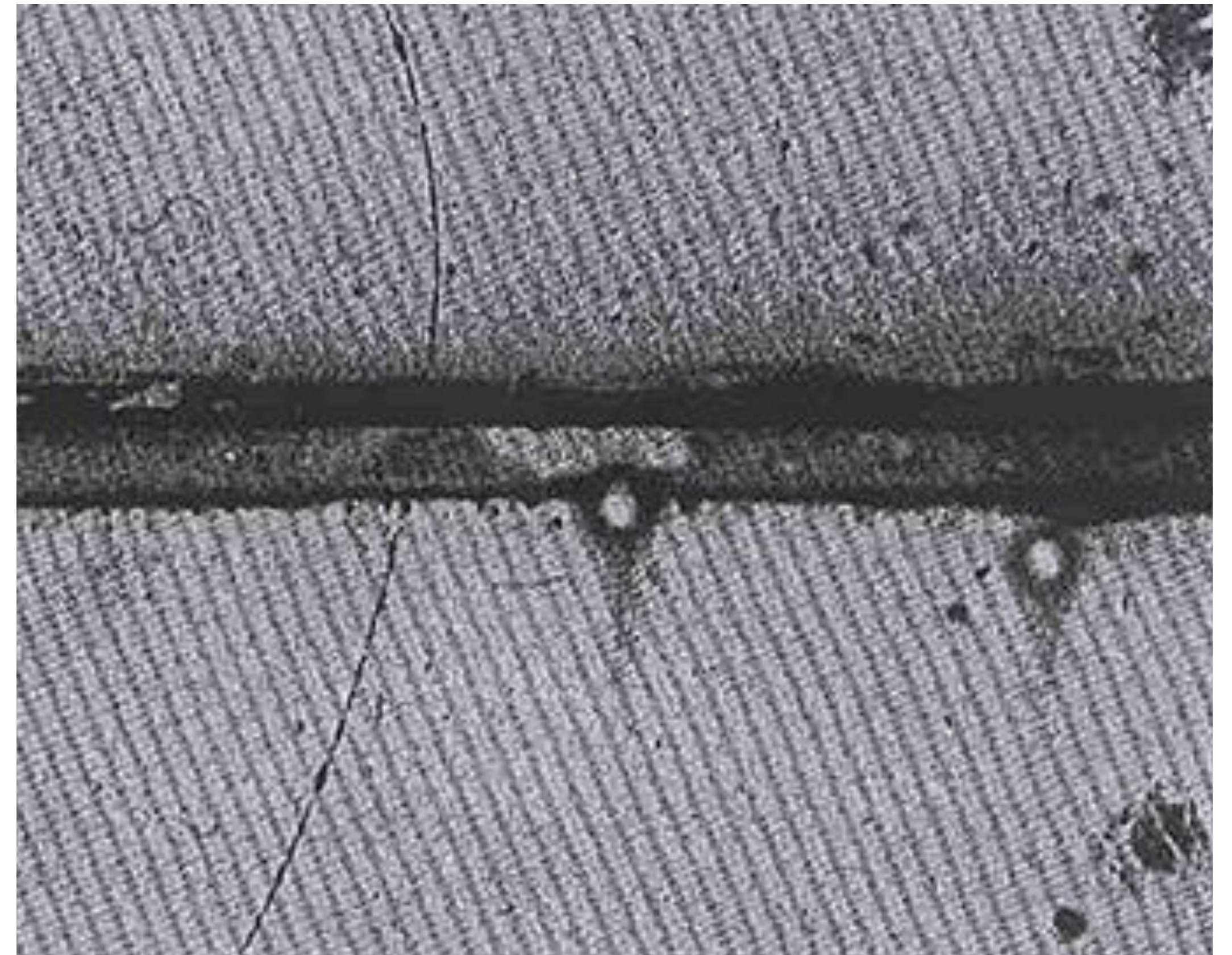
At the same time the energy needed to power will be provided and the switch to electric vehicles will continue to take place.

The planet can then begin to open its lungs, along with everyone on it, whilst carbon filters clean what's left and manage the residual CO<sub>2</sub> generated by the remaining fossil fuel burning cars and industry.

Climate accords and agreements will become irrelevant and meaningless, humanity can then begin to focus on solving the other problems we have. Evolution negates the need for revolution.

# Investment Highlights & Transaction Summary

- £2 million seed funding required
- SEIS / EIS eligible
- UK 'Patent Box' corporation tax
- UK R&D tax credits
- UK/EU Space Agency grants available
- IP license and royalty business model with multi £Trillion market.



The discovery of antimatter (the Positron) by Carl Anderson, 1933



# Use of Proceeds

- Marketing of IP
- Protection of IP
- Increase value of IP - initially through proof of concept in laboratory
- Extend breadth of IP - internationally and through enhanced R&D
- Recruiting and training consultant engineers - centre of expertise for Dirac Drives and antimatter propulsion and energy.

# Contacts

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More....

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Education: <https://youtu.be/r2AHCYTIVAg>

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Thank you.



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